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In situ produced cosmogenic nuclides in GISP2 rock core from Greenland summit

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Three distinct zones were identified in a 155-cm rock core recovered from beneath the ice sheet at the GISP2 site in Greenland: a surface boulder layer, an underlying zone of unconsolidated silt and the granitic bedrock. We determined the cosmogenic surface exposure ages of the boulder layer and of the bedrock to study the history of the Greenland ice sheet. Cosmogenic ^{10}Be, ^{26}Al, and ^{21}Ne were measured in quartz separated from samples at three depths in the rock core: a sample of the boulder (23-33 cm from the top of core) and two bedrock samples (47-63 cm and 142-155 cm).

Preliminary results for the cosmogenic radionuclide concentrations in the GISP2 rock core indicate that the gradient of ^{26}Al concentrations between the two bedrock samples is similar to that predicted from the spallation attenuation length of cosmic rays at the earth's surface. This similarity implies that the bedrock must have experienced only a minimum amount of coverage by either ice or soil during its exposure to cosmic rays. It also implies that the bedrock surface could not have been extensively eroded by glacial action once the ice sheet built up sufficient thickness to shield the bedrock from cosmic rays. Based on ^{26}Al to ^{10}Be ratios in two samples, the bedrock and boulder surfaces were exposed to cosmic rays (no ice cover) as recently as about 0.5±0.2 My ago. This suggests that the Greenland ice sheet is at least a few times younger than other studies have predicted. The low concentrations of cosmogenic nuclides suggest that cosmic ray exposure lasted for a very short time. Assuming that the unglaciated surface was 1,000 m higher in elevation than is the current bedrock surface, an exposure period on the order of 4-7 ky is indicated without shielding. The quartz in these samples contains a large amount of radiogenic Ne isotopes, which makes it difficult to measure the small cosmogenic ^{21}Ne component. << Nevertheless, preliminary ^{21}Ne results suggest a slightly longer exposure time than calculated from ^{10}Be and ^{26}Al. >> Further discussion will have to await the completion of additional cosmogenic nuclide measurements.

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